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Task 2N Alternative Needs Planning Methods

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May 23, 1980

Mr. Coye Bridges, XRBF
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Dear Coye:

Enclosed are the descriptions "Alternative Needs Planning Methods" and the "Scenario Approach" which are deliverable under Tasks 2_N and 4(a) respectively of Contract No. F33600-80-C-0414.

Sincerely,

J. Douglas Hill
Research Leader
Defense Systems & Technology Section

JDH:eah

Encs.

TASK 4(a). SCENARIO APPROACH

INTRODUCTION

Leading industrial companies and government organizations now recognize the value of developing and using scenarios in strategic planning. The use of scenarios has been prompted by experience that shows strategic plans based on trends and expected events are not adequate. Key events and discontinuities in trends have shaped the present environment for most institutions; other events and discontinuities are likely to shape the future environment. One way to take into account such key events and discontinuities is through the development and use of multiple scenarios. Such scenarios can be used for testing plans and, if need be, for contingency planning. Starting in the early to mid-70's, the use of scenarios is now recognized as an important part of the planning process.

The report outlines an approach for multiple scenario development representing alternative future environments in which the Air Force's Logistics Management Systems (LMS) must be developed, operated, and managed.

BACKGROUND

There is a growing literature dealing with the methods of scenario development. Much of that literature deals with cross-impact analysis and other formalized models used in scenario formulation. A classic paper*, although published in 1975, is still the best summary dealing with the nature, shape, credibility, and utility of scenarios. The following relies heavily on Battelle's experience and on that paper.

Scenarios, What Are They?

Scenarios are descriptions of the future. Multiple scenarios are alternative descriptions of the future. For maximum usefulness, however,

*Zentner, Rene D., "Scenarios in Forecasting", Chemical and Engineering News, October 6, 1975. A more recent paper, "The Use of Multiple Scenarios by US Industrial Companies" by Robert E. Linneman and Harold E. Klein, Long Range Planning, 12, February 1979, pp 83-90 discusses the purposes, methods and results of scenario development and use--but not so openly and comprehensively.

the descriptions should be limited to those forces of change, trends or events, that will have a significant impact on the future of the activity being planned. Hence, scenarios cover trends and events such as demographic changes, technological futures, political shifts, social trends, and economic conditions. The multiple scenarios to be developed for AFLC, therefore, must be derived from only those trends and events that will have a major impact on the design and operation of AFLC's LMS.

How Many Scenarios Are Needed?

There is obviously no limit to the number of alternative futures that could be conceived and described in the form of scenarios. From a practical point of view, however, the number is constrainted to a relatively few by the ability of the planning system to assimilate and use the scenarios. In most planning situations three scenarios are used. As Zentner said, "Indeed four may be too many to keep track of unless characterized by strong readily differentiated characteristics".

What Themes Are Important?

It is clear that the selection of scenario themes is one of the most critical steps in the development and use of scenarios. Ideally each scenario developed would treat one of the major issues affecting the future of the organization. Industrial firms may consider major issues dichotomies in government policy, major differences in the level of US economy, or high and low levels of energy availability and price.

Considerable thought must be given to the identification and selection of themes for the scenarios developed in this project. They should include only the most significant forces external to AFLC design and operation of LMS.

What is the Final Form?

Experience shows that all scenarios to be considered in a planning cycle should have the same length and degree of development. This means that

each should be taken into account with the same seriousness during the planning process. Most industrial firms who have used scenarios over a period of years tend to agree that the natural tendency is to make them too long and too detailed. These firms make major efforts to reduce the length of scenarios and to increase the ease of their communication. Shell Oil, for example, maintains an effort to reduce size of a "bound indexed scenario digest" to less than 50 pages. This would indicate that each single scenario would be about 15 pages. Experience by others indicates that even this length may be a burden in the planning process.

It is clear that every effort should be made to reduce the size and length and complexity of each scenario so that the overriding theme and its underline logic stands out.

How Scenarios Are Generated

Scenarios are generated by people who have insights into possible future trends and events and their impacts on the organization. The scenarios themselves are generated through a series of steps involving the identification and assessment of such trends and events. From a listing of such trends and events groups of them are identified by a variety of formal and informal methods. A group of trends and events that appear to be internally consistent, therefore represents a possible scenario which may be subsequently reduced to a narrative about the future.

Acceptance and Use of Scenarios

It is obvious that the use of scenarios in a planning situation depend on their creditability and understandability. Both of these characteristics derive from the level of internal consistency among the trends and events of a single scenario. Regarding internal consistency, Zentner observed "Successful scenarios are more than just a bundle of forecasts and projections, they unfold with a logic and consistency that give them creditability to the reader. Judgment and discipline are required to coordinate the economic features with the political, the social, and with the technological."

PLAN

The plan that has been developed consists of four steps.

Step 1. Prepare Outline of Scenario Format

Based on the above, the scenario format should be characterized by a clear theme stated in the title. The nature of the theme and the major trends and events for each scenario should standout clearly. The trends and events that synergistically shape the theme can be represented in a simple diagram. If the most significant trends and events can be clearly ordered in time, the narrative of no more than 10 or 12 pages should be sufficient to describe a set of forces of change and the major vector of their consequences.

This plan, together with the above generalized outline of a scenario format, will be reviewed with a select sample of companies using scenarios as inputs to strategic planning. Included as possible candidates to be included in the sample are Shell Oil, DuPont, and General Electric. The plan may be refined to some degree. At this time also the next deliverable, "Scenario Format", will be prepared and submitted.

Step 2. Identify and Select the Most Significant Trends and Events, External to AFLC That Could Have Major Impact on the Nature and Operation of LMS

It would be essential at the outset of this step to identify the activities (or functions) at each of the three levels of LMS--strategic directive and production. These levels and related activities were defined to some degree in the AFLC/XRB planning package entitled "Information for Planning" dated June 7, 1979. The activities at any or all of the three levels can be influenced by future trends and events. Lists of activities therefore represent areas of potential impact.

Next the plan calls for the use of group techniques to assist in the listing of trends and events and the nature and level of their impacts. Prior to the group meetings, briefing charts would be prepared in a generalized

relevance tree format to facilitate communications of the impact areas (activities or functions of the LMS) and the nature of the trends and events that we hope to identify.

It is envisioned that knowledgeable people from the Battelle Columbus staff and from XRB will be selected and group meetings held at the XRB office and the Battelle Columbus office. During these group meetings the forecasts prepared last year would be systematically reviewed in an attempt to identify those trends and events that could have the greatest impact either singularly or in combination on AFLC's LMS.

It may be necessary in a subsequent assessment by the Battelle staff to winnow the list of such trends and events down to relatively few, say 15 to 20.

Step 3. Develop Themes for Possible Scenario Development

In order to develop cohesive scenarios around clearly identifiable themes it will be essential to catagorize the major trends and events selected in Step 2. There are a number of methods that can be used as aids. Consideration will be given to a multidimensional technique for catagorization described by Ducot and Lubben*. In addition, relationships among the selected trends and events will be explored through cross-impact analysis.

On the basis of identified relationships, major themes will be identified and selected for each of the several groups of trends and events that appear to be related to one another and cohesive enough to form a rudimentary scenario. It is expected that each of these rudimentary scenarios will be described in the form of a diagram indicating the nature of the theme and the more important relationships among the related trends and events. At this time, it is impossible to visualize the exact number of such rudimentary scenarios. It is anticipated that five or six might be identified.

*Ducot, C. and Lubben, G. J., "A Typology for Scenarios", Futures, February 1980, pp. 51-57.

A selection will be made of the three scenarios that appear to be preferred for this planning cycle. Each will be outlined in detail. A diagram indicating the theme and relationship of trends and events will be prepared. With this outline and diagram and agreed upon format a preliminary narrative version for each of three scenarios will be prepared.

Step 4. Review, Modify, Edit and Publish Final Scenarios

During the general officer review in July each of the 5 or 6 rudimentary scenarios will be covered, with the reasons for the recommendation of the final three. Feedback from this review will guide the modification, and editing of the final scenarios.

ALTERNATIVE NEEDS PLANNING METHODS

The purpose of this effort was to identify a usable decision process for the group planning sessions to be held from July 7 to 16, 1980. At least 50 different methods exist for idea generation. Several steps were necessary to select the appropriate method or methods to be used. These steps were:

1. To develop some selection criteria
2. To describe the problem(s) under consideration
3. To develop a list of methods available and a brief description of each
4. To screen the list to a reasonable number of candiates based on preliminary criteria
5. To examine prime candidates in more detail.

During the first step, the following criteria for selection of a group process were defined.

Criteria for Selection of a Group Process

1. Objective of the Group Process: idea generation, conflict resolution, arriving at a consensus, information presentation, simple pooling of the individual judgements
2. Time required to use the method
3. Size of group best for the method to work effectively
4. Time that must elapse before results from the process are available for further processing
5. Cost to use the method
6. Required proximity of the participants
7. Special leadership needed to accompnay a particular method (If so, is such leadership available or must it be developed?)
8. Special setting requirements
9. Special tools needed to carry out the method
10. Proven usefulness of the method in situations with similar requirements to the one being considered
11. Training needed for the participants to engage in using the method
12. Capacity of the method relative with the scope of the problem.

Concurrent with this effort, the planning groups were briefly described, and each session was outlined regarding its principal objective. The Needs Identification Group was subdivided into two separate areas. The first was designated the LMS Policy Planning Group, and the second was the LMS Needs Identification Group. Participants in these groups were identified in a deliverable under Task $3(a)_N$ dated 5 May 1980.

LMS Policy Planning Group Sessions

The objective of these sessions will be to confirm or establish policy related forecasts. These forecasts would include consideration of organizational changes within the Air Force and AFLC; the relationship between DoD and the Air Force with regard to logistics; war-readiness philosophy; and contingency plans for management during emergencies. These forecasts will consider ranges of possible futures rather than a single forecast.

LMS Needs Identification Group

The objective of these sessions will be to identify LMS needs for the portion of the system defined by a particular LAG (or part of a LAG). These needs will take into consideration the various scenarios supplied to the participants.

Parallel sessions are planned using different planning methodologies. The participants would, therefore, be divided equally between the sessions. Some of the participants will be selected because of particular expertise related to the selected LAG. Between 15 and 25 people are expected to be involved. It is anticipated that individual groups will be limited to about eight people.

Details of the sessions with both the LMS Policy Planning Group and the LMS Needs Identification Group are under development as part of Task $3(b\text{-}1)_N$.

Literature Survey

The next phase of the effort was a survey of the literature to develop a list of candidate planning methods. (Appendix A) after a preliminary review of this list, eleven methods were selected which seemed particularly well adapted to the situations to be addressed. These eleven methods were matched with the Selection Criteria established in Step 1. Figure 1 presents the results of this evaluation. Based on this effort, six techniques were tentatively identified to be applied in these planning sessions. Those selected are:

1. Delphi
2. Nominal Group Technique
3. Brainwriting Pool
4. Interpretative Structural Modeling
5. Interacting Group
6. Q-Sort.

More detailed descriptions of the selected techniques are presented in Appendix B.

The advantages and disadvantages of these techniques are briefly described in the following sections.

FIGURE 1. ATTRIBUTES OF GROUP PLANNING METHODS

METHOD AND DESCRIPTION	OBJECTIVES					TIME			GROUP SIZE			ELAPSE TIME	COST	APPLICATION			REQUIRES PROXIMITY	SPECIAL LEADERSHIP	SPECIAL SETTING	SPECIAL ANALYSTS AND TOOLS	PROVEN METHOD	PARTICIPANT TRAINING	NATURE OF THE PROBLEM			Mostly Creative (C) or Analytical (A)
	Prioritization/ Ranking	Conflict Resolution	Consensus	Idea Generation	Pooling of Information	1 Session	2-3 Sessions	Several Sessions or Longer	4 or less	5-9	10 or more			Top Management	Middle Mgt.	Scientists and Engineers							Narrow in Scope	Medium in Scope	Broad in Scope	
DELPHI An effective way of utilizing expert opinions, characterized by anonymity, controlled feedback, and statistical response.			X		X		X	X			X	High				X	No	X	No	X	X	No			X	A
BRAINSTORMING An uninhibited approach to ideation, particularly for the purpose of breaking down broadly defined problems into their essential elements. A group approach only.				X		X				X		Low		X	X	X	X	X	No	No	X	No	X			C
BRAINWRITING POOL Brainwriting stresses written communication, sometimes augmented with oral communication.				X		X				X		Low		X	X	X	X	No	No	No	X	No	X			C
NOMINAL GROUP TECHNIQUES A structured group meeting that combines silent generation of ideas in writing with group discussion and voting to establish priorities.	X	X	X	X	X		X			X		Medium			X	X	X	X	No	Simple	X	No	X			C
SYNECTICS A highly structured group approach to problem solving based on the repeated use of various analogies and metaphors that provide unique contexts for seeing the problem from widely divergent points of view. A group approach only.	X			X		X				X		Medium -High		X	X	X	X	Very Special X	X	No		X	X	X		C
INTERACTING GROUP An unstructured discussion group.					X	X			X	X		Low-Medium		X	X	X	X	No	No	No		No	X	X	X	—
MORPHOLOGICAL MATRIX A structured approach to finding combinations of ideas by identifying the problem variables along both axes of a matrix and plotting the interrelationships among the variables in the corresponding squares within the body of the chart.				X		X			Very Small Group (Usually One Person)			High				X	X	No	No	No	X	No		X		C

FIGURE 1. (Continued)

METHOD AND DESCRIPTION	OBJECTIVES					TIME			GROUP SIZE			ELAPSE TIME	COST	APPLICATION			REQUIRES PROXIMITY	SPECIAL LEADERSHIP	SPECIAL SETTING	SPECIAL ANALYSTS AND TOOLS	PROVEN METHOD	PARTICIPANT TRAINING	NATURE OF THE PROBLEM			(C) (A)
	Prioritization/ Ranking	Conflict Resolution	Consensus	Idea Generation	Pooling of Information	1 Session	2-3 Sessions	Several Sessions or Longer	4 or less	5-9	10 or more			Top Management	Middle Mgt.	Scientists and Engineers							Narrow in Scope	Medium in Scope	Broad in Scope	
ATTRIBUTE LISTING Applied principally to improving tangible objects or things, the technique consists first of listing the parts and the essential features or attributes of the object, then systematically modifying these to improve the object.				X		X				X		Medium				X	X	No	No	No	No	No	X			C
Q-SORT A psychometric method for classifying items according to the opinions of a group of persons and for evoking group consensus on these classifications.	X	X	X			X				X		Low		X	X	X	X	No	No	Simple	No	No	X			A
KSIM A cross-impact language that involves embedding, which uses symbols entered in a matrix to represent the strength or intensity of the relationship between the variables.			X			X	X		X	X		Medium			X	X	X	X	For 1 Session	X		No	X			A
INTERPRETIVE STRUCTURAL MODELING A computer-assisted method whereby a group structures a set of ideas in terms of a selected, relevant, type of relation among the ideas.		X	X			X			X	X		Medium	30-40/ hr.	X	X	X	X	X	X (Computer)			No	X			A

SELECTED TECHNIQUES

Delphi Technique

Objectives

1. To determine or develop a range of possible program alternatives
2. To explore or expose underlying assumptions or information leading to different judgements
3. To seek out information which may generate a consensus on the part of the respondent group
4. To correlate informed judgements on a topic spanning a wide range of disciplines
5. To educate the respondent group as to the diverse and interrelated aspects of the topic.

Benefits

1. The isolated generation of ideas in writing produces a large quantity of ideas.
2. The process of writing responses to the questions forces respondents to think through the complexity of the problem, and to submit specific, high-quality ideas.
3. Search behavior is proactive since respondents cannot react to the ideas of others.
4. The anonymity and isolation of respondents provides freedom from conformity pressures.
5. Simple pooling of independent ideas and judgements facilitates equality of participants.
6. The Delphi process tends to conclude with a moderate perceived sense of closure and accomplishment.
7. The technique is valuable for obtaining judgements from experts geographically isolated.

Weaknesses

1. The lack of opportunity for social-emotional regards in problem solving leads to a feeling of detachment from the problem-solving effort.

2. The lack of opportunity for verbal clarification or comment on the feedback report creates communication and interpretation difficulties among respondents.

3. Conflicting or incompatible ideas on the feedback report are handled by simply pooling and adding the votes of group respondents. Thus, while this majority rule procedure identifies group priorities, conflicts are not resolved.

Nominal Group Technique (NGT)

Objectives

1. To assure different processes for each phase of creativity (information-generation vs. reaching a solution).
2. To balance participation among members.
3. To incorporate mathematical voting technique in the aggregation of group judgment.

Benefits

1. Low variability among groups in member and leader behavior leads to consistency in decision making.
2. A balanced concern for social-emotional group maintenance roles and performance of task-instrumental roles offers both social reinforcement and task accomplishment reward to group members.
3. The silent independent generation of ideas, followed by further thought and listening during the round-robin procedure, results in a large quantity of ideas.
4. Search behavior is proactive, characterized by extended periods in generating and clarifying alternative dimensions of the problem, tendencies for high task-centered group effort, and the generation of new social and task-related knowledge.
5. The structured process forces equality of participation among members in generating information on the problem.
6. NGT meetings tend to conclude with a perceived sense of closure, accomplishment, and interest in future phases of problem solving.

Weaknesses

1. Extended preparation for NGT meetings is necessary to clearly identify the information desired from a group, and to provide the necessary supplies. NGT, therefore, is not a spontaneous group meeting technique.
2. Inflexibility of the structured NGT format makes it difficult to make adjustments or to change topics in the middle of a meeting. NGT is generally limited,therefore, to a single-purpose, single-topic meeting.
3. Conforming behavior to a structured format is required on the part of all participants, a condition which is not immediately comfortable to inexperienced participants.

Brainwriting Pool

Objectives

Use group participation to facilitate the generation of creative decision alternatives as problem solutions.

Benefits

1. All members of the group are working in parallel, instead of singly in sequence.
2. The silence and the presence of others creates a mild tension, an atmosphere of production, a commitment to produce, and continuing evidence of progress.
3. Reading what others write provides a continuing learning opportunity, and a stimulus to thought.
4. The absence of verbal criticism reinforces open thinking.
5. Each individual has time to think, without interference.
6. Every idea gets recorded, none is lost.
7. Dominance by strong personalities is precluded.
8. Premature closure is precluded.
9. Minority ideas are not stifled.
10. Conflicting, incompatible ideas are given an opportunity to be aired.
11. Hidden agendas or covert political group dynamics have no opportunity to obfuscate idea generation.
12. Responsibility for group success is shared.
13. All participants feel a burden to help produce.
14. A sense of greater permanence is engendered by the process of writing, which provides incentive.
15. A strong focus is provided, which helps achieve greater penetration in depth.
16. The capacity to contribute is not adversely affected by the number of people involved.

Weaknesses

1. No immediate feedback to participants.
2. No chance to discuss or clarify ideas.

Interpretive Structural Modeling

Objectives

1. To extend capacity to define complex systems and enhance interdisciplinary efforts to communicate about system improvement.
2. To develop an efficient process for generating interpretive structural models.
3. To provide methods for iterative revision and correction of extracted structural models.

Benefits

1. Allows the user to structure a large set of elements while considering only two of the elements at a time.
2. Enhances learning and communication among the participants
3. A tool for approaching multi-criteria decision making in a structured way.

Weaknesses

1. Requires a priori identification of the elements.
2. Requires a priori definition of a precise, transitive, and applicable "relationship" among the elements.

Interacting Group

Objectives

Exhange and communication of information and ideas.

Benefits

1. Attitude change
2. Team building
3. Increasing a sense of group consensus
4. Increasing group motivation and cohesion.

Weaknesses

1. Because interacting group meetings are unstructured, high variability in member and leader behavior occurs from group to group.
2. Discussion tends to fall into a rut, with group members focusing on a single train of thought for extended periods, and with relatively few ideas generated.
3. The absence of an opportunity to think through independent ideas results in a tendency for ideas to be expressed as generalizations.
4. Search behavior is reactive and characterized by short periods of focus on the problem, tendencies for task avoidance, tangential discussions, and high efforts in establishing social relationships and generating social knowledge.
5. High-status, expressive, or strong personality-type individuals tend to dominate in search, evaluation, and choice of group products.
6. Meetings tend to conclude with a high perceived lack of accomplishment.

Q-Sort

Objectives

1. To create a forum where parties can articulate feelings and opinions which may assist them in formulating a self-awareness of their own value strucutres.
2. To permit a ranking of projects that seem to defy quantification.

Benefits

1. Simple technique to use
2. Group anonymity largely preserved
3. Results are recorded and tallied
4. Improves communication.

Weaknesses

1. Too imprecise to yield final decisions
2. Multitude of iterations required to classify many projects on several criteria
3. Can be used only by participants very familiar with the projects.

APPENDIX A

APPENDIX A

Methods for Stimulating Ideas

Brainstorming and Its Variations

Brainstorming uses group participation to facilitate the generation of creative decision alternatives. In this strategy an unstructured group works together to develop a list of alternative solutions to a problem. To encourage free expression, the group works under three rules:

(1) ideas are freely expressed without considering their quality

(2) group members are encouraged to modify and combine previously stated ideas, and

(3) a moratorium is placed on the evaluation of ideas until all ideas have been stated.

Classical Brainstorming

These are the rules of classical brainstorming:

(1) The leader reminds the group of the problem definition and reminds them of the rules of classical brainstorming.

(2) The leader insures that all participants join in the discussion.

(3) The leader suppresses his own ideas as long as the group is generating ideas.

(4) The leader injects a new idea when the group well goes dry.

(5) There is absolutely no criticism of ideas expressed.

(6) Careful listening is critical; do not interrupt others.

(7) Thorough presentation of an idea is not required. Keep the ideas short. If full detailing is appropriate, it can come after the meeting.

(8) Speak out on all ideas that come to mind in relation to the problem.

(9) The leader writes short key word descriptions of all ideas on a board or flip chart. The scribe keeps more detailed records.

(10) The leader may reread the list of ideas as a means of stimulating new ideas.

Anonymous Brainstorming

The essential ingredients and rules are the same as for classical brainstorming, except as follows:

(1) The participants supply ideas in writing before the meeting to the leader.

(2) The leader presents the ideas to the group in the meeting without identifying the source of the ideas.

Didactic Brainstorming

The essential ingredients and rules are the same as for classical brainstorming, except as follows:

(1) The problem is not defined for the participants before the meeting.

(2) At the meeting, the leader unfolds the problem little by little, presenting successively greater amounts of information as ideas are developed by the group.

Destructive/Constructive Brainstorming

This method differs considerably from classical brainstorming.

(1) Two meetings are held instead of one.

(2) In the first meeting, ideas are presented and then criticized in all possible ways, by prior agreement.

(3) In the second meeting, solutions to the inadequacies generated in the first meeting are presented and elaborated.

"And Also" Brainstorming

This method differs from classical brainstorming as follows:

(1) Each idea must be thoroughly discussed before another one can be suggested.

Creative-Collaboration Brainstorming

This method differs from classical brainstorming as follows:

(1) Following the classical brainstorming exercise, the participants separate, write down, and submit to the leader new ideas or variations of ideas generated in the classical brainstorming exercise.

Buzz Session Technique

This method differs from classical brainstorming as follows:

(1) The number of people involved can be large.

(2) The assembly is broken up into groups of 6.

(3) Each group conducts a classical brainstorming session for 5-10 minutes.

(4) The leader of each group then reports to the assembly.

(5) The small groups then reconvene and conduct a second classical brainstorming session, making use of the stimuli obtained from the previous small group reports.

(6) Several iterations can be achieved, if desired.

Imaginary Brainstorming

This differs from classical brainstorming in that:

(1) The problem is modified to eliminate some of the constraints in order to promote fuller expression of ideas. A classical brainstorming session may be held or a variant used.

(2) A second meeting is held in which the total problem is unveiled, and the best of the ideas from the first session are repeated. The brainstorming session then considers how to implement the good ideas.

SIL Method

This method differs considerably from classical brainstorming. With this method:

(1) Six to eight participants write down solutions to a stated problem.

(2) The first participant reads his solution, as does the second.

(3) The group then tries to integrate the two solutions.

(4) Another participant reads his solution, and the group tries to integrate the three solutions.

(5) This process continues until all solutions have been read.

(6) If some solution is deemed better than all previous ones as integrated, it is accepted. The emerging solution becomes more concrete and detailed as the integration proceeds.

Brainwriting and Its Variations

Brainwriting stresses written communication, sometimes augmented with oral communication.

Method 635

(1) The number of participants is 6.

(2) The problem is explained and discussed. No particular leadership qualifications are vital.

(3) Each participant writes three relevant ideas on a paper.

(4) Each participant gives his page to his neighbor.

(5) The original ideas are developed further on paper by those receiving the other's ideas; or new ideas are added.

(6) Every five minutes the pages are passed on to the next person.

(7) When each person has received the page he started with, the session has ended.

(8) The pages are collected, and the ideas are evaluated later.

(9) The meeting will take about 50-60 minutes.

Brainwriting Pool

(1) There are 4-8 participants.

(2) At the beginning, some ideas previously developed are placed in a pool of pages.

(3) Each participant starts with a blank sheet and puts his ideas on the sheet. When he finds that ideas no longer are coming to him, he puts his sheet in the pool and takes another sheet from the pool.

(4) After 30-40 minutes, the exercise is terminated.

(5) Evaluation is done later.

Idea Delphi

(1) Several rounds occur.

(2) The participants may not even know each other.

(3) Contributions in written form from the first round are circulated to the entire group, whereupon the second round commences. In the second round ideas from the first round are refined.

(4) After two rounds, the results are circulated, and evaluation is to be done. Participants state which ideas seem most promising.

Idea Card Collection

(1) Here the participants come together for a meeting.

(2) Ideas of each participant are written on cards, and the cards are collected.

(3) The ideas are pooled and returned to the group without identifying the source of the ideas.

(4) The process proceeds as with the Idea Delphi.

Idea Engineering

The purpose of this scheme is to permit a systematic process of idea generation to take place in a given organization.

Step 1. A goal is set by management.

Step 2. Participants are chosen.

Step 3. The team analyzes the goal and the reasons for posing it, along with preparing arguments and hypotheses for achievement on cards.

Step 4. Ideas are collected, and central findings are rephrased as problems to be solved. These are fed back to the group, and a second round of writing on cards ensues.

Step 5. The solutions are checked and evaluated by another group of "experts". From this, an action program is evolved.

In carrying out Step 3, a group of 4-6 participants should follow alternate discussion and writing phases ranging from 5-10 minutes.

Collective Notebook Method

Instead of the cards employed in the Idea Engineering scheme, each participant is asked to put down ideas daily in an idea notebook that contains a description of the problem.

Ultimately, these notebooks are collected and become the basis for a second round.

Trigger Method

After definition and analysis of the problem, each participant writes some key ideas.

(1) The first participant reads his ideas to the small group.

(2) His ideas are discussed for about 10 minutes to develop the key ideas.

(3) Repeat for another participant and so on.

(4) Ideas once discussed are not repeated.

(5) New ideas triggered by the first round become the basis for a second round.

(6) As many as five rounds may be done in one session. Hence such a session could last for several hours (but only with experienced groups).

Methods of Creative Confrontation

It is believed that the introduction of strangeness in a situtation stimulates people to think in new ways. Methods of creative confrontation are based on this principle.

Classical Synectics

The rules of classical brainstorming apply to this method. However, additional structure is introduced in that there is an attempt to stimulate the four stages of creative process. These are intensive consideration of the problem, estrangment from the problem, illumination, and verification. A very experienced leader is required for the small group. The methodological aspects of classical synectics center on the estrangment stage.

Ten steps are employed:

(1) Introduction to the problem, analysis of it, and definition of it.

(2) Full exposition of ideas for solution, as in classical brainstorming.

(3) Redefinition of the problem.

(4) Forming direct analogies for the problem in a wide-ranging field of possibilities.

(5) Forming of personal analogies wherein each individual identifies with an analogy and presents courses of action based on the analogy selected.

(6) Forming of contradictory analogies wherein a spectacular personal analogy is transformed by the group into a contradicting symbolic analogy. For example, if the personal analogy is "I feel like a butterfly", a symbolic analogy would be "heavy lightness".

(7) Seeking real analogies for the symbolic analogy.

(8) Analysis of the real analogy is done in a precise way.

(9) Relating the real analogy to the problem under consideration.

(10) Developing of solutions.

At least 90 minutes is required for this process, which should be carried out with conscious attention to assure that each step is recognizable by the group.

Synectic Conference

The synectic conference is like classical synectics, except the strict regulation of steps is relaxed. However, the emphasis upon generation of analogies is retained.

Prior training of the participants in classical synectics is required.

Visual Synectics

Here pictures, such as color slides, are employed to suggest analogies. Each picture is described and analyzed by a member of the group. Then the group tries to relate the picture to the problem under consideration. Posters have also been used in visual synectics.

Stimulus-Analysis

Here the group produces 10 concrete terms which are then the stimulus for a discussion. The terms play the same stimulus role as the pictures used in visual synectics.

Battelle-Belmuden Brainwriting
(BBB Method)

This is a variant of brainwriting, as well as a method of creative confrontation. In this method, a brainstorming session is held to generate known or trivial solutions to the problem. The participants are supplied with picture folders. Each participant then writes solutions that are stimulated by the pictures; later the solutions of each participant are read to the group. Through group interaction further solution variants are developed. This method has been applied successfully by the Battelle-Frankfurt staff.

Force-Fit Game

Between two and eight people form two crews. One participant serves as referee and secretary. One crew starts and mentions an idea remote from the problem. The other crew tries to develop a solution from this idea with two minutes. They score a point if the referee believes that they were successful; otherwise the other crew scores a point. This process continues for about half an hour.

Neighboring Field Integration

Three steps are used.

(1) Identify the neighboring fields of the problem; i.e., matters that have some recognizable association with the problem.

(2) Form a set of (perhaps 10) concrete terms or events through free association with the neighboring field.

(3) Use these terms or events as stimuli for the generation of new solutions.

Semantic Intuition

Here a name is generated for a hypothetical invention through a combination of two ideas. Then an invention is sought that would fulfill the name. For example, suppose garden elements and human activities form two sets. By pairing one element from each set a name is obtained. Then an invention is sought. As an example, "path cleaner", where a path is an element of a garden and cleaning is a human activity.

Catalog Technique

From a catalog or text, two ideas are chosen at random and a connection is sought.

Nominal Group Technique

NGT meeting is a structured techniuqe designed to incorporate a number of group processes. There are several steps involved which include:

(1) Select generation of ideas in writing

(2) Round-robin recording of ideas

(3) Serial discussion for clarification

(4) Preliminary vote in item importance

(5) Discussion of preliminary vote

(6) Final vote.

Q-Sort

This procedure focuses on the rather natural individual/group decision making process that must take place in project selection/evaluation. It is a valuable aid to the heuristic idea-exchange process, though too imprecise to yield final decisions.

Systematic Structuring

Systematic structuring methods generally differentiate first, then integrate. Differentiation develops a set of sharply defined problem elements; integration relates them in a systematic whole.

Morphological Box

Construction of a morphological box involves five steps.

(1) Describe, define, and generalize the problem.

(2) Define all factors which influence the solution.

(3) Put the factors into distinctive categories.

(4) Choose one "cell" of the box for analysis. A cell will consist of one factor from each category.

(5) Evaluate the various cells in terms of criteria for solution.

This is the method used by the Doxiadis organization to determine alternative options for recommendations to improve human settlements. With some extension they call it the IDEA method.

Function Analysis

With this method, the various functions relevant to the problem are developed, and alternative ways of performing these are generated for comparison.

Attribute Listing

All attributes of an object or existing system are listed, then an effort is made to modify these attributes to derive a better outcome.

Process Analysis

A detailed analysis of flows in the system being studied is made.

Interpretive Structural Modeling

In using this process, a computer is employed as an aid in organizing the knowledge. A set of elements germane to the problem is developed (brainwriting may be used as a means to generate such a set), and then a particular contextual relation is selected for use in interrelating the elements. Thus this method is largely integrative in nature. The element list is supplied to a computer, which then questions the group of no more than eight people. A chairperson takes votes on the question and feeds the answers to the computer. The computer then develops the structure of the replies, organizing the elements in a multilevel graph. For small sets of elements the computer can be replaced by a skilled analyst.

Progressive Abstraction

In this method, the scope of the problem is systematically enlarged by uncovering progressively larger neighboring fields (see the "Neighboring Field" method discussed earlier). As a result, several levels of problem redefinition may be achieved, whereupon one may be selected as appropriate for further study.

K-J Method

Each statement or piece of information about a problem is written on a card. The cards are sorted into stacks, each stack representing similar ideas. These stacks are then given names which are placed on cards and put with the stacks. The stack titles may themselves be sorted into similar groups, etc., thus organizing the information.

N-M Method

This method is like the K-J method, except that analogies may be introduced to stimulate thought.

Cross Impact (KSIM)

Cross-impact analysis is a method for revising estimated probabilities of future events in terms of estimated interactions among those events.

APPENDIX B

Descriptions of Selected Tools

- Delphi
- Nominal Group Techniqe
- Brainwriting
- Interpretive Structural Modeling, (ISM)
- Interacting Group
- Q-Sort

APPENDIX B

ITEM	EXAMPLE
1. Name	Delphi Technique
2. Capsule Description	A method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.
3. Typical Product or Result	The product is a median-date forecast for each event, a measure of the disagreement still remaining, and arguments and reasons for establishing the dates.
4. Intermediate Results	Each person can contribute anonymously, but receive feedback from other participants.
5. Number of people involved	Varies greatly with application
6. Facilities Required	None, unless group large enough to require computer analysis of contributions
7. Time Required	Varies with group proximity, necessary time delays between rounds.
8. Cost Components	Monitor time, clerical, secretarial time, computer usage.
9. Appropriate Conditions for Use	When there is a need to equalize information to and from all respondents; a need to minimize psychological effects; and to minimize time demanded of respondents or conferees.
10. Outline of Methodology, Process, Technique, etc.	A. Formulate questionnaires to which group is expected to respond B. Distribute questionnaires. Each member is to estimate date by which there is a 50-50 chance the event will have occurred. C. Director calculates median and quartiles for each event and revises event statements if confusing or ambiguous. D. Second-round questionnaire is distributed, revised if necessary with median and quartiles for each event. Committee members reconsider their original estimates and submit second

round estimate. If it falls above third or below first quartile, he is expected to justify his position.

E. Sequence continues until there is no longer any significant change of opinion between rounds.

F. Committee forecast is final round median date.

11. References

Harold A. Linstone & Murray Turroff (Eds.) The Delphi Method, Addison-Wesley, 1975.
Joseph Martino, "Tools for Looking Ahead", IEEE Spectrum, October, 1972.

12. Examples of Use

The National Drug - Abuse Policy Delphi - 1974, Plastics and Competing Materials by 1985, 1971; An Experimental Public Affairs Forecast by National Industrial Conference Board.

ITEM	EXAMPLE
1. Name	Nominal Group Technique.
2. Capsule Description	A method for focusing a group discussion on a specific question(s) and generating ideas or answers in a short time.
3. Typical Product or Result	The product is a list of ideas about the question(s), possible answers, causative factors, priorities.
4. Intermediate Results	Each person can contribute anonymously but discuss ideas of everyone.
5. Number of People Involved	Minimum: At least four people. Maximum: Approximately 8-12 without dividing the group into subgroups.
6. Facilities Required	Each group needs writing space where they are together yet not clustered. Standard paper and pencils are satisfactory. A large pad (flipcharts) or blackboards for displaying results are useful.
7. Time Required	Minimum: 1 hour. Maximum: Approximately two days although sessions could run longer.
8. Cost Components	Leader training, travel, participants time, lodging.
9. Appropriate Conditions For Use	When there is a need to rapidly draw-out foremost ideas from a group about some question, and it is desirable to obtain these from selected individuals meeting together at one location for a day or two.
10. Outline of Methodology, Process, Technique, etc.	A. Formulate question(s) to which the group is to respond. B. Gather participants into groups of 8-12 or less (down to 4) with writing facilities at hand. (The balance assumes one group. The process is somewhat flexible.) C. Require each person for a specified period to write ideas on a page. Allow no exchange of ideas or discussion.

10.	Outline of Methodology, Process, Technique, etc. (Continued)	D. Collect the ideas and list them at random on flip charts or blackboard. E. Discuss ideas for clarification and understanding only for a specified time. F. Have each person on paper vote to rank ideas. Collect votes and mark concensus on flip charts. G. Discuss voted rankings and ideas listed for a specified time. Permit limited debat. H. Vote again on rankings. Collect votes and correct ranking.
11.	References	Van de Ven and A. L. Delbecq, "Nominal vs Interacting Group Processes for Committee Decision-Making Effectiveness", Journal of Academy of Management. Van de Ven and Delbecq, "A Group Process Model for Problem Identification and Program Planning", Journal of Applied Behavioral Science, Vol. 7, No. 4.
12.	Examples of Use	ACP Urban Leadership Roundtable, BRCP-1974 Forest Research Council (Georgia) Prioritizing FRC Program, 1974 Georgia Tech- Technology Assess.

ITEM	EXAMPLE
1. Name	Brainwriting Pool.
2. Capsule Description	Brainwriting pool is a method for generating ideas about some question within a small group.
3. Typical Product or Result	The product is a list of ideas about the question, possible answers, comments, etc.
4. Intermediate Results	Each member sees the ideas of other members, and each member contributes his own ideas.
5. Number of People Involved	Minimum: At least four people. Maximum: Any number of groups can work in parallel if sufficient facilities are available, but no more than eight should work in any one group.
6. Facilities Required	Each group needs a table that will accommodate up to eight. Standard size paper and pencils are needed. Optional use of a large pad or blackboard for displaying results to all members is often desirable, but is not necessary.
7. Time Required	Minimum: Four people working 15 minutes, for a total of 1 man-hour. Maximum: With optional discussion allowed, 2N man-hours, where N is the number of participants.
8. Cost Components	Participant's time.
9. Appropriate Conditions for Use	Use whenever there is a need for quite a few ideas about some question, and it is appropriate to obtain these from a number of individuals working together at one location.
10. Outline of Methodology, Process, Technique, etc.	A. Formulate the question to which the group is to respond. B. Gather the group around a table, or split into several groups as indicated above.

10. Outline of Methodology, Process, Technique, etc. (Continued)

C. There is no conversation during the process.
D. Each person writes a few ideas on a page, then puts his page in the pool, and draws another partially-filled page from the pool.
E. After reading what is written on the page from the pool, the person writes additional ideas on the page and returns it to the pool.
F. The process continues until each member has read everything in the pool and has no further ideas to contribute.
G. (This and succeeding steps are optional.) If there are several groups, the product of each group is given to another group.
H. Each group edits the product of another group to eliminate redundancy and improve clarity.
I. Each group presents to a plenary session their version of what another group produced.
J. Discussion follows for clarification.

11. References

Van de Ven and A. L. Delbecq, "Nominal and Interacting Group Processes for Committee Decision-Making Effectiveness", Journal of the Academy of Management.

12. Examples of Use.

A. Meeting of Central Ohio Transit Authority Board, fall, 1974, to generate list of possible objectives for the Authority.
B. American Management Associations Senior Management Program, fall, 1974, to generate ideas for motivating successful young executives.
C. Academy for Contemporary Problems, Urban Leadership Roundtable, to generate potential ingredients of national urban growth policy.

ITEM	EXAMPLE
1. Name	Interpretive Strucutral Modeling
2. Capsule Description	A computer-assisted method whereby a group structures a set of ideas in terms of a selected, relevant, type of relation among the ideas.
3. Typical Product or Result	A "map" of the structural relation among the ideas in the set.
4. Intermediate Results	A sharpening of the ideas in the set. A considerable amount of productive exchange among members of the group, which expands perceptions of relations among the ideas being structured.
5. Number of People Involved	Mode 1. No Observers. Can have only one person, but normally would range up to eight. Mode 2. Observers. Same as mode 1, except that the number of observers can be very high. For example, with suitable arrangements, a television auidence can view the exercise and learn from the discussion that goes on.
6. Facilities Required	Mode 1. With no observers, what is needed is a suitably programmed computer, an input device connected to the computer (by remote telephone line), a set of TV display units for the computer to communicate with the participants, a group leader, a data manager who handles information flow to the computer, and a comfortable working environment for the group of participants. Mode 2. Additional space for observers, and display units they can see, or appropriate facilities for remote telecasting.
7. Time Required	Variable, depending on the amount of preparation, the difficulty of the problem, the number of participants, and the reliability of the equipment and data manager. Can take as little as 30 minutes on simple exercises, and can consume several sessions ranging from 2 to 4 hours each.

8. Cost

Cost per hour is about $30 to $40 for equipment, plus the cost of time of the participants, if Mode 1 is used. If Mode 2 is used, costs would be considerably higher, if telecasting is used.

9. Appropriate Conditions

Use when a set of ideas is available, and there is a need to understand better how these ideas relate to each other.

10. Outline of Methodology, Process, Technique, etc.

A. Start with a set of elements (ideas) germane to some learning theme.
B. Determine a type of contextual relation relevant to these elements, which can be used to develop a structure.
C. Determine whether the contextual relation appears to be transitive in character. If it is not, the method does not apply.
D. Supply the element set and relation to the computer.
E. Arrange the facilities and collect the group.
F. The computer puts questions to the group, to which the group responds. Majority voting is used to determine responses to the computer questions.
G. The computer structures the collective responses.
H. The element set is sharpened as the process proceeds.
I. The computer-generated structure is corrected, using computer assistance.
J. If the structure contains cycles, further attention may be given to the fine structure of the cycles. The computer can assist in this process.
K. If desired, the cycles themselves may be partially structured, by working with a subset of cycles called geodetic cycles.
L. Documentation is written to explain the structures evolving from this process.

11. References

J. N. Warfield, Structuring Complex Systems, Battelle Monograph No. 4, April, 1974.

12. Examples of Use

Numerous examples appear in Battelle Monograph No. 7, Portraits of Complexity, edited by M. M. Baldwin, to appear in April, 1975.

ITEM	EXAMPLE
1. Name	Interacting Groups
2. Capsule Description	An unstructured group process
3. Typical Product or Result	Highly variable
4. Intermediate Results	Process can contribute to team building and increasing a sense of group consensus
5. Number of People Involved	Minimum: Four Maximum: Eight
6. Facilities Required	A meeting room with suitable seating arrangement
7. Time Required	30 minutes to 2 hours
8. Cost Components	Travel Individual's time
9. Appropriate Conditons for Use	Generally superior when soliciting evaluation information. Can be designed to permit systematic sharing of information by the group, which promotes agreement.
10. Outline of Methodology, Process, Technology, etc.	Structuring depends on purpose of the group. Can use an "estimate - discuss - estimate" sequence in seeking consensus from a group.

ITEM	EXAMPLE
1. Name	Q-Sort
2. Capsule Description	Psychometric method for classifiying items according to the opinions of a group of persons, and for working group consensus on these classifications.
3. Typical Product or Result	A tally chart which reveals the extent of group disagreement in ranking projects
4. Intermediate Results	Process highlights areas of undisclosed problems in communications and inter-departmental cooperation
5. Number of People Involved	Minimum: 4 Maximum: 15
6. Faciliities Required	Meeting room and tally charts
7. Time Required	30 minutes to 2 hours
8. Cost Components	Travel Individual's time
9. Appropriate Conditions for Use	Limited number of criteria to consider in classification and participants well informed on projects
10. Outline of Methodology, Process, Technology, etc.	A. The individuals successively sorts items into a series of preconceived categories B. When sorting is finished, each participant announces his results which are compiled in a tally chart C. Tally charts are used as a basis for discussion. Participants may share opinions, challenge each other, or proceed as they wish. D. Following the discussion period, a second round sort is performed and tallied. E. Process is generally followed by a more formal mathematical project selection model.
11. References	Arthur F. Helen and William E. Souder, "Experimental Test of a Q-Sort Procedure for Prioritizing R&D Projects", IEEE Transactions on Engineering Management, Vol. EM-21, No. 4, November 1974.